

COMPARISON OF CAPTURE-RECAPTURE AND VISUAL COUNT INDICES OF PRAIRIE DOG DENSITIES IN BLACK-FOOTED FERRET HABITAT

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ABSTRACT.—Black-footed ferrets (*Mustela nigripes*) are dependent on prairie dogs (*Cynomys* spp.) for food and on their burrows for shelter and rearing young. A stable prairie dog population may therefore be the most important factor determining the survival of ferrets. A rapid method of determining prairie dog density would be useful for assessing prairie dog density in colonies currently occupied by ferrets and for selecting prairie dog colonies in other areas for ferret translocation. This study showed that visual counts can provide a rapid density estimate. Visual counts of white-tailed prairie dogs (*Cynomys leucurus*) were significantly correlated ($r = 0.95$) with mark-recapture population density estimates on two study areas near Meeteetse, Wyoming. Suggestions are given for use of visual counts.

Recovery of the endangered black-footed ferret will involve the careful management of the only known population near Meeteetse, Wyoming, as well as captive breeding and translocation. Both ferret preservation and population recovery are dependent on the presence of prairie dog colonies. Ferrets have been most frequently observed in or near prairie dog colonies (Cahalane 1954, Henderson et al. 1969), and their original distribution probably corresponded closely to the range of the black-tailed (*Cynomys ludovicianus*) and white-tailed prairie dogs (Hall 1981). The black-footed ferret relies on the prairie dog for approximately 90% of its diet (Henderson et al. 1969, T. M. Campbell personal communication) and on prairie dog burrows for shelter and rearing young. Prairie dog populations declined dramatically during the last century because of loss of habitat and poisoning. From an estimated 283 million ha occupied in the late 1800s (Merriam 1902), prairie dog colonies declined to less than 0.6 million ha by 1971 (Cain et al. 1971). The decline of the black-footed ferret during the last century is probably linked to the reduction in prairie dog populations.

A model using growth rates of Siberian polecats to simulate those of black-footed ferrets estimated the annual prey requirement of the black-footed ferret to be 214 black-tailed prairie dogs (Stromberg et al. 1983). They assumed an intrinsic rate of growth of 1.5 for

prairie dog populations and calculated the prairie dog population size required to support a ferret at 766. Because white-tailed prairie dogs are larger, their model predicted the annual prey requirement to be 186 animals and the required population size to be 666. In telemetric studies, a radio-tagged black-footed ferret preferred areas of dense prairie dog burrows within its home range (Biggins et al. 1985), and we postulate that high prairie dog densities are important to ferrets.

A rapid method of determining prairie dog population density needs to be developed that can be used to assess the prairie dog populations at Meeteetse and that would allow us to monitor prairie dog populations at frequent intervals for potential problems, such as plague outbreaks or effects of oil development. A rapid density estimation procedure also could be used to assess prairie dog populations in colonies being considered for ferret translocation.

Prairie dog population numbers have been estimated using a variety of methods. Mark-recapture is a reliable method for estimating the density of prairie dogs because these animals have relatively small home ranges and are readily trapped. However, mark-recapture is labor intensive and can be done only on relatively few plots; it is therefore impractical for estimating animal density over large areas. Closing burrows and counting the number

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reopened after 1 or 2 days is a method frequently used in conjunction with control programs, where pretreatment and posttreatment counts are compared to determine the effectiveness of rodenticide applications to prairie dog populations (Tietjen 1976). The method provides an index to prairie dog activity that may have little correlation with actual population trends (Knowles 1982); results can be variable with this technique because one prairie dog can reopen more than one burrow.

Visual counts may provide a quick method of measuring prairie dog density; prairie dogs are well suited for visual counts because of their large size, their diurnal activity patterns, and their tendency to live in social colonies. Visual counts were used by Knowles (1982) to estimate black-tailed prairie dog numbers, but their precision was not assessed for white-tailed prairie dogs. This study evaluated the use of visual counts to monitor white-tailed prairie dog densities by comparing visual counts with mark-recapture data.

STUDY AREA

The study was conducted 30 km southwest of Meeteetse, in Park County, Wyoming. White-tailed prairie dogs occur in colonies on about 3000 ha (Clark et al. 1984) throughout this area. We studied two colonies located between 2280 and 2380 m in elevation on short- to midgrass rangeland.

METHODS

Mark-Recapture

Prairie dog populations were censused by mark-recapture during May and July 1984 and May 1985. A 360 x 360 m trapping grid was established on each of the two study colonies using 169 National³ live traps (48 x 15 x 15 cm) located at 30 m intervals. The grid was subdivided into nine 120 x 120 m subplots. Before each trapping period, the traps were wired open and baited with flaked oats for a two-day familiarization period. During the subsequent five-day trapping period, the traps were baited with oats and checked during the morning; they were closed at midday to avoid prairie dog mortality caused by heat stress. The trapped prairie dogs were aged (juvenile or adult), sexed, ear-tagged with monel No. 1

fingerling fish tags, and released at the point of capture. Population estimates for each of the trapping periods were computed using the computer program CAPTURE (White et al. 1978). Otis et al. (1978) have provided a detailed reference on the theory behind program CAPTURE.

Visual Counts

Prairie dogs on the study area were observed prior to the initiation of this study. They exhibited a bimodal activity pattern with peak numbers aboveground between 0700 and 1000 hours and with a second but lower peak between 1500 and 1800 hours. This bimodal activity pattern is similar to that observed by Tileston and Lechleitner (1966) and Clark (1977) for white-tailed prairie dogs and by Althen (1975) for black-tailed prairie dogs. Visual counts were therefore conducted during the peak activity period in the morning on four consecutive days following the trapping period. During May 1984 prairie dogs were counted from portable 3-m-high towers erected in the center of each 120 x 120 m subplot. Counts from the center of each subplot proved labor intensive, so during July 1984 and May 1985 prairie dogs were counted from two locations outside the entire 360 x 360 m grid; observers were located a minimum of 30 m from the grid to minimize disturbance of animals. Two observers counted the grid from each location. Prairie dogs on each 120 x 120 m plot were counted during a four-minute period by scanning the plot with binoculars and a 15X spotting scope. Three counts were made daily of each plot during a two or three-hour period. Plots were counted in the same sequence and at synchronized times by observers at both locations. Prairie dogs that were located on the borders between two plots were counted if they were on the north and east edges and not counted if on the south and west edges.

Statistics

Simple linear correlation coefficients were computed (1) between the highest total count of individual prairie dogs over the entire 360 x 360 m grid and the population density generated by program CAPTURE for the corresponding five-day period and (2) between the highest single count of individual prairie dogs

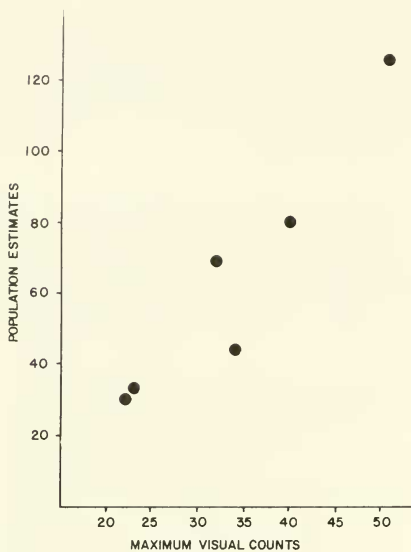


Fig. 1. Prairie dog population estimates on 360 by 360 m grids (x-axis) plotted against maximum visual counts on the same areas (y-axis). The simple linear regression equation is: $y = 15.56 + 0.28x$.

per 120 x 120 m plot and the number of prairie dogs trapped on that plot during the corresponding five-day trapping period (insufficient numbers of prairie dogs were trapped on each 120 x 120 m plot to generate a satisfactory population density).

The variation associated with location, observer, day, and trial (three counts per day) was determined using a procedure on SAS (SAS 1985) that estimates variance components (PROC VARCOMP).

RESULTS

There was a high correlation between the population densities estimated by CAPTURE and the highest number of animals counted visually across the entire 360 x 360 m grid during the corresponding period ($r = 0.95$, $P = 0.004$, Fig. 1). The simple linear regression equation is: $y = 15.56 + 0.28x$, where y is the maximum visual count and x is the population density. Population density correlated better with visual counts than the total number of

animals trapped ($r = 0.84$). Also, the maximum number counted provided a better correlation than the average of a series of counts ($r = 0.74$).

There was a lower correlation between the highest count and number trapped per 120 x 120 m sub-plot ($r = 0.69$); when analyzed separately by time period the correlation was highest during May 1984 ($r = 0.86$) and lower during July 1984 and May 1985 ($r = 0.70$ and 0.61 , respectively). Visual counts on small areas may therefore not be as representative of actual densities as counts on larger areas.

Variance component estimation revealed that trials (counts per day) accounted for the most variation in the data (Table 1). This was expected because counts were begun in the morning as prairie dogs emerged from burrows and were continued until prairie dogs became less active above ground in midmorning. During any day, counts were normally low at first, increased to the maximum count, then decreased. Location accounted for a large portion of the variation in the data on area 1 but only a small portion of the variation on area 2. Location was important on study area 1 because tall grass grew on a portion of the study area between the time the area was chosen and the time when visual counts were begun. The grass made counting prairie dogs on part of the plot difficult from one of the two locations.

When trials were removed from the analysis and only the maximum count by each observer per day was used, location still accounted for a large portion of the variation in the data on area 1. Day variation was small for area 1 (only one-third of location variation) but was comparatively large for area 2. Observer variation was negligible, but a large variance component existed for observer-day interaction. This would indicate that variability was present between observers over the four-day period but that observers had no consistent bias toward high or low counts.

DISCUSSION

Visual counts appear to provide a useful index to prairie dog population densities that can be used to monitor prairie dog populations at Meeteetse and to assess ferret relocation sites. Mark-recapture is a reliable

TABLE 1. Components of variance for prairie dog visual counts of two study areas near Meeteetse, Wyoming. On each study area, counts were conducted over a four-day period from two locations by two observers at each location. The magnitude of the variance indicates the relative influence of each item in the model to the overall variation.

Source	df	Area 1	Area 2	Area 1 ¹ maximum count	Area 2 ¹ maximum count
Location (L)	1	11.34	1.54 ²	20.77	-2.64
Observer (O) in L	2	2.73	-0.44	-0.54	-3.17
Day (D)	3	-1.49	3.60	6.70	13.92
D x L	3	21.75	4.81	-15.94	-3.55
O x D in L	6	-4.38	-2.41	44.62	14.67
Trial in O x D	32	33.96	23.77		

¹Trials were removed from this analysis, the maximum count per observer per day was analyzed.

²Negative variances are usually considered to be zero.

method for estimating the abundance of white-tailed prairie dogs because these animals are readily trapped and have relatively small home ranges. The estimates of density using mark-recapture and visual counts were independent of one another in this study and produced comparable results. Therefore, unless both methods were equally biased, the accuracy of visual counts was probably good. Knowles (1982) found that visual counts of black-tailed prairie dogs provided a good correlation between maximum counts and population levels ($r = 0.942$).

Size of areas counted influences the reliability of visual counts. Visual counts on small areas of 1 to 1.5 ha did not correlate as well with numbers of animals trapped on those areas because of the increased edge effect on the smaller areas or because prairie dog home ranges exceeded the area counted and movement occurred between areas of locally high and low densities. Size of areas counted should therefore be 10 ha or greater if possible.

Because maximum counts provided better correlations with prairie dog population densities than the mean of a series of counts, counts should be made during peak activity periods in early morning or late afternoon. Trials (counts per day) accounted for the most variation in the data because counts were made from the time prairie dogs emerged early in the morning until they disappeared as temperatures increased. Because of this variation, it is important that visual counts be made over a two- or three-hour period during peak prairie dog activity so a count of maximum numbers above ground is included. Because prairie dog activity is suppressed by high and

low temperatures (e.g., below 10 C or above 27 C) and strong winds (Davis 1966, Althen 1974), counts should be conducted when weather conditions are moderate.

Seasonal variation also exists in the percentage of prairie dogs active above ground (Tilston and Lechleitner 1966, Clark 1977). Individual prairie dogs are active for only four to five months during the year. Adults emerge from hibernation in early spring and become inactive in midsummer, whereas juveniles appear above ground in early June and remain active until late October or November. The total population therefore attains its maximum size during late June and early July when adults and juveniles are above ground at the same time. Surveys during this period would therefore most accurately reflect total population levels.

Substantial variation occurred among locations when observers at one of the locations on area 1 were not able to see portions of the plot well because of intervening tall grass. Locations of observers for conducting counts should therefore be chosen carefully so the entire area to be counted is readily visible. In areas of flat topography the roof of a vehicle provided a good location from which to make visual counts.

The variance component for days was small for area 1, indicating that counts made on one day might be sufficient. However, the variance component was larger for area 2. A zero variance component existed for observers in this study, indicating that different individuals could count on different days and an accurate estimate of population density could still be obtained. However, because a large component was associated with observer-day in-

teraction and because a large day component was present on one area, we recommend that counts be made over several days by the same observer.

Although visual counts can be a precise method of estimating prairie dog populations, they should be used with caution. Precision is based upon their repeatability. Therefore, the observer, location, and time of day should remain constant between one count and the next whenever possible. The area to be counted should be predetermined and its boundaries well marked so that prairie dogs outside the area will not be counted. Systematic scans of an area for predetermined time periods can minimize the possibility of counting animals more than once; the only animals counted twice are those that move across the study area during the scan. If conducted following the guidelines suggested, visual counts can be a valuable technique for estimating prairie dog densities.

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